Claims

[c1] A system comprising: a device for acrylamide detection in any food or food substance and necessary materials required to detect concentration of said acrylamide, a means for collecting a sample of said food or food substance to be mixed in a solution for dissolving said food substances and subsequently placing said solution onto a substrate; said substrate comprising a material containing an appropriate enzyme that, along with a co-enzyme and/or some form of energy and/or a metal and/or catalyst, facilitates conversion of acrylamide to a chemical fragment of acrylamide that can be easily detected and measured.

[c2] A system as in Claim 1, wherein said substrate material contains: an appropriate enzyme or other substituent to facilitate an enzymatic or other conversion from acrylamide to acrylonitrile, and a detection and measurement technique that is sensitive to acrylamide or acrylonitrile.

[c3] A system as in Claim 1, wherein said substrate material contains: an appropriate enzyme or other substituent to facilitate an enzymatic conversion from acrylamide to ammonia, and a detection and measurement technique that is ammonia sensitive.

[c4] A system as in Claim 2, wherein said detection and measurement technique that is acrylonitrile sensitive includes: an infrared (IR) sensor to measure a sample of said food or food substance and an acrylamide concentration of said sample from an amount of converted acrylonitrile within said sample by identifying an absorption peak of a carbon-nitrogen (C≡N) triple bond in acrylonitrile in an IR spectra at 2250 cm^{-1} wavelength, a display indicating a concentration of said acrylonitrile, and a scale that is representative of the concentration of acrylamide in said

food or food substance as related to said concentration of said acrylonitrile.

[c5] A system as in Claim 3, wherein said detection and measurement technique that is ammonia sensitive includes: an ammonia-sensitive film strip containing a chromophore that is sensitive to and detects ammonia or an ammonia specific membrane recognizing ammonia concentration by correspondence with an electric signal; a colorimetric display showing the concentration of ammonia detected; and; a scale that is representative of the concentration of acrylamide in said food or food substance.

[c6] A system as in Claim 3, wherein said detection and measurement technique that is ammonia sensitive includes: an ammonia-sensitive mechanical, electrical, biochemical, or microbiological apparatus that is sensitive to and detects ammonia, and; a numeric display to indicate the concentration of ammonia.

[c7] A system as in Claim 1 wherein said enzyme is nitrilase.

[c8] A system as in Claim 1 wherein said enzyme is amidase.

[c9] A system as in Claim 1 wherein said enzyme is formamidase.

[c10] A system as in Claim 1 wherein said enzyme is nitrilase from Nocardia rhodochrous LL100-21.

[c11] A system as in Claim 1, wherein said enzyme is AmiE aliphatic amidase.

[c12] A system as in Claim 5, wherein said chromophore is bromophenol blue.

[c13] A system as in Claim 5, wherein said chromophore is bromocresol green.

[c14] A system as in Claim 5, wherein said chromophore is chlorophenol red.

[c15] A system as in Claim 1, wherein said system and substrate material is maintained in a biochip.

[c16] A system as in Claim 1, wherein said co-enzyme is used and its reaction product is coupled to a colorimetric change.

[c17] A system as in Claim 1, wherein said energy source is used and its reduction is coupled to a secondary detection system.

[c18] A system as in Claim 1, wherein said catalyst is utilized and its modification is detectable by a secondary detection method.

[c19] A system as in Claim 1, wherein a test with said device is completed at home and is also suited for sending to a laboratory for detailed concentration of acrylamide analysis.

[c20] A system as in Claim 2, wherein said detection and measurement technique that is acrylamide and/or acrylonitrile sensitive includes: a LUMI-CELL^{TM} sensor or equivalent technique that measures an acrylamide and/or acrylonitrile concentration within a sample of a prepared food substance and a comparative scale that is representative of the concentration of acrylamide and/or acrylonitrile in said food or food substance or a cell derived from said food or food substance.

[c21] A system as in Claim 2, wherein said detection and measurement technique that is very highly sensitive to acrylamide and/or acrylonitrile includes: reacting said acrylamide or a reactive chemical fragment from a portion of said acrylamide with an amino acid of a protein such that production of monoclonal antibodies will occur and; coupling said antibodies with a colored dye substance such that said colored dye

substance will indicate concentration of antibodies that bind to said protein, wherein said detection and measurement technique is optionally combined with a biochip for home, office, or laboratory use.

[c22] A device comprising: a means for acrylamide detection in any food or food substance and necessary materials required to detect a concentration of said acrylamide, a means for collecting a sample of said food or food substance to be mixed in a solution for dissolving said food or food substance and subsequently placing said solution onto a substrate; said substrate comprising a material containing an appropriate enzyme that, along with a co-enzyme and/or some form of energy and/or a metal and/or catalyst facilitates conversion of acrylamide to a chemical fragment of an acrylamide that can be easily detected and measured.

[c23] A device as in Claim 22, wherein said substrate material contains: an appropriate enzyme or other substituent to facilitate an enzymatic conversion from acrylamide to acrylonitrile, and a detection and measurement technique that is acrylonitrile sensitive.

[c24] A device as in Claim 22, wherein said substrate material contains: an appropriate enzyme or other substituent to facilitate an enzymatic conversion from acrylamide to ammonia, and a detection and measurement technique that is ammonia sensitive.

[c25] A device as in Claim 22, wherein said detection and measurement technique that is ammonia sensitive includes: an ammonia-sensitive film strip containing a chromophore that is sensitive to and detects ammonia or an ammonia specific membrane recognizing ammonia concentration by correspondence with an electric signal; a colorimetric display showing the concentration of ammonia detected; and; a scale that is

representative of the concentration of acrylamide in said food substance.

[c26] A device as in Claim 22, wherein said detection and measurement technique that is ammonia sensitive includes: an ammonia-sensitive mechanical, electrical, biochemical, or microbiological apparatus that is sensitive to and detects ammonia, and; a numeric display to indicate the concentration of ammonia.

[c27] A device as in Claim 22 wherein said enzyme is nitrilase.

[c28] A device as in Claim 22 wherein said enzyme is amidase.

[c29] A device as in Claim 22 wherein said enzyme is formamidase.

[c30] A device as in Claim 22 wherein said enzyme is nitrilase from Nocardia rhodochrous LL100-21.

[c31] A device as in Claim 22 wherein said enzyme is AmiE aliphatic amidase.

[c32] A device as in Claim 25 wherein the chromophore is bromophenol blue.

[c33] A device as in Claim 25 wherein the chromophore is bromocresol green.

[c34] A device as in Claim 25 wherein the chromophore is chlorophenol red.

[c35] A device as in Claim 22 wherein said system and substrate material is maintained in a biochip.

[c36] A device as in Claim 22 wherein said co-enzyme is used and its reaction product is coupled to a colorimetric change.

[c37] A device as in Claim 22 wherein said energy source is used and its reduction is coupled to a secondary detection system.

[c38] A device as in Claim 22 wherein said catalyst is utilized and its

modification is detectable by a secondary method.

[c39] A device as in Claim 22, wherein the test of said test device is completed at home and is suited for sending to a laboratory for detailed low-concentration acrylamide analysis.

[c40] A device as in Claim 22, wherein said detection and measurement technique that is acrylamide and/or acrylonitrile sensitive includes: a LUMI-CELL™ sensor or equivalent technique to measure via a light source an acrylamide and/or acrylonitrile concentration within a sample of a prepared food or food substance and a comparative scale that is representative of the concentration of acrylamide and/or acrylonitrile in said food or food substance.

[c41] A system as in Claim 2, wherein said detection and measurement technique that is very highly sensitive to acrylamide and/or acrylonitrile includes: reacting said acrylamide or a reactive chemical fragment from a portion of said acrylamide with an amino acid of a protein such that production of monoclonal antibodies will occur and; coupling said antibodies with a colored dye substance such that said colored dye substance will indicate concentration of antibodies that bind to said protein, wherein said detection and measurement technique is optionally combined with a biochip for home, office, or laboratory use.

[c42] A method for detecting acrylamide or traces thereof in any food or food substance, comprising: detecting acrylamide concentrations in said food or food substance using materials in a test device; collecting a sample of said food or food substance for mixing in a dissolving solution; facilitating conversion of acrylamide to ammonia by using a substrate material containing an enzyme along with a co-enzyme and/or a form of energy

and/or a metal/catalyst; detecting by an ammonia-sensitive film strip with a chromophore that is sensitive to and detects ammonia; displaying a concentration of ammonia detected using a colorimetric display; and; providing a scale that is representative of said concentration of acrylamide in said food or food substance.

[c43] A method for determining a specific concentration of acrylamide in a sample of any food or food substance comprising: detecting acrylamide concentrations in said food or food substance using materials in a test device; a means for collecting a sample of said food or food substance to be mixed in a solution for dissolving said food or food substance and subsequently placing said solution on a substrate; said substrate comprising a material containing an enzyme that, along with a co-enzyme and/or energy source and/or a catalyst that facilitates conversion of acrylamide to ammonia; an ammonia-sensitive film strip containing a chromophore, such as bromophenol blue, that is sensitive to and detects ammonia; a colorimetric display showing a concentration of ammonia detected, and; a scale that is representative of a concentration of acrylamide in said food or food substance and optionally; further utilizing said film strip by sending said strip to a laboratory for analyses.

[c44] A method for determining a specific concentration of acrylamide in a sample of any food or food substance comprising: detecting acrylamide concentrations in said food or food substance using materials in a test device; a means for collecting a sample of said food substances to be mixed in a solution for dissolving said food substances and subsequently placing said solution onto a substrate of said device; said substrate comprising a material containing an enzyme that, along with a co-enzyme and/or energy source and/or catalyst facilitates conversion of acrylamide

to acrylonitrile; an infrared (IR) sensor to measure a sample and quantify the concentration of acrylonitrile within said sample by an absorption peak of the carbon-nitrogen (C≡N) triple bond in acrylonitrile in an IR spectra at 2250 cm^{-1} wavelength; a display showing said concentration of acrylonitrile detected, and; a scale that is representative of said concentration of said acrylamide in said food substance.

[c45] A method for determining a specific concentration of acrylamide in a sample of any food or food substance comprising: detecting acrylamide concentrations in said food or food substance using materials in a test device; a means for collecting a sample of said food or food substance to be mixed in a solution for dissolving said food or food substance and subsequently placing said solution onto a substrate of said device; said substrate comprising a material containing an enzyme that, along with a co-enzyme and/or energy source and/or catalyst that facilitates the conversion of acrylamide to acrylonitrile; an infrared (IR) sensor to measure a sample and quantify the concentration of acrylonitrile within the sample by an absorption peak of the carbon-nitrogen (C≡N) triple bond in acrylonitrile in an IR spectra at 2250 cm^{-1} wavelength; a display showing said concentration of acrylonitrile detected, and optionally; a scale that is representative of said concentration of said acrylamide in said food substance, and optionally further utilizing the device in a biochip.

[c46] A method for determining a specific concentration of acrylamide that is very highly sensitive to said concentration of acrylamide and/or acrylonitrile in any sample of food or food substance comprising; reacting said acrylamide or a reactive chemical fragment from a portion of said acrylamide with an amino acid of a protein such that production of

monoclonal antibodies will occur and; coupling said antibodies with a colored dye substance such that said colored dye substance will indicate concentration of antibodies that bind to said protein, wherein said detection and measurement technique is optionally combined with a biochip for home, office, or laboratory use.

[c47] A method for determining a specific concentration of acrylamide in any sample of food or food substance comprising: detecting acrylamide concentrations in said food or food substances using materials in a test device; a means for collecting a sample of said food substances to be mixed in a solution for dissolving said food substances and subsequently placing said solution onto a substrate of said device; said substrate comprising a material containing an enzyme that, along with a co-enzyme and/or energy source and/or catalyst optionally facilitates conversion of acrylamide to acrylonitrile; a LUMI-CELL™ sensor to measure a sample and quantify the concentration of acrylamide and/or acrylonitrile, a display showing said concentration of acrylamide and/or acrylonitrile detected, and; a scale that is representative of said concentration of said acrylamide and/or acrylonitrile in said food substance.

[c48] A method for providing an acrylamide-free processed food or food substance by processing said food or food substance such that conversion of asparagine in the presence of reducing sugars within said food substance is eliminated.

[c49] A method for providing an acrylamide-free processed food substance by processing said food substance such that conversion of asparagine in the presence of reducing sugars within said food substance is reduced.

[c50] A system for providing an acrylamide-free processed food substance by

processing said food substance such that conversion of asparagine in the presence of reducing sugars within said food substance is eliminated, wherein said system comprises a method of measuring a concentration of any potentially remaining trace of acrylamide.

[c51] A system for providing an acrylamide-reduced processed food substance by processing said food substance such that conversion of asparagine in the presence of reducing sugars within said food substance is reduced, wherein said system comprises a method of measuring a concentration of any potentially remaining trace of acrylamide.

[c52] The method of claim 48, wherein said method comprises; processing said food substance below 120 C or processing said food substance by changing the pH of a food processing process or adding a constituent to said food processing process that blocks a reaction pathway for the formation of acrylamide in the presence of reducing sugars and heat or removal of said reducing sugars from said food substance or any combination thereof that accomplishes elimination or reduction of acrylamides from said processed food substances.

[c53] A system for providing either the reduction of or elimination of acrylamide concentrations in foods by providing competitive inhibition in a reaction pathway that would otherwise lead to acrylamide formation including; a). use of small organic acids including ascorbic acid, glutamic acid, acetic acid, and the like b). use of sodium gluconate or other similar acidic sugars sufficient to replace reducing sugars in foods containing reducing sugars c). raising or lowering pH in combination with or absent of lowering temperature within processing of said foods by any means sufficient to eliminate or reduce formation of acrylamides using acidic or basic mediums or cultures during processing.

[c54] A system for labeling foods that contain low or no concentration of acrylamides for a consumer wherein said system provides safety for a consumer, such labels to be included on packaging of said foods and on shipping or handling containers of said foods and directly on said foods where appropriate.

[c55] A device for providing labels or any labeling technique that specifies acrylamide free or low in acrylamides referring to a measured concentration of acrylamides in foods known to form acrylamides during processing.

[c56] The system of claim 54, wherein said foods include any foods that initially contain carbohydrates and asparagine which when processed form acrylamides.

[c57] The system of claim 54, wherein said foods include but are not limited to coffee, potato chips, French fries, corn chips, cookies, crackers, cereals, breads, pizza dough, submarine sandwich breads, and the like.

[c58] The system of claim 54, wherein said packaging or container is plastic, metal, or wood or any combination thereof wherein said packaging or container is labeled according to a specific concentration of acrylamides.

[c59] The system of claim 54, wherein said concentration is certified by any independent test laboratory or any government regulatory agency.